Piloting An Integrated Renewable Energy Portfolio for the UC Merced Community

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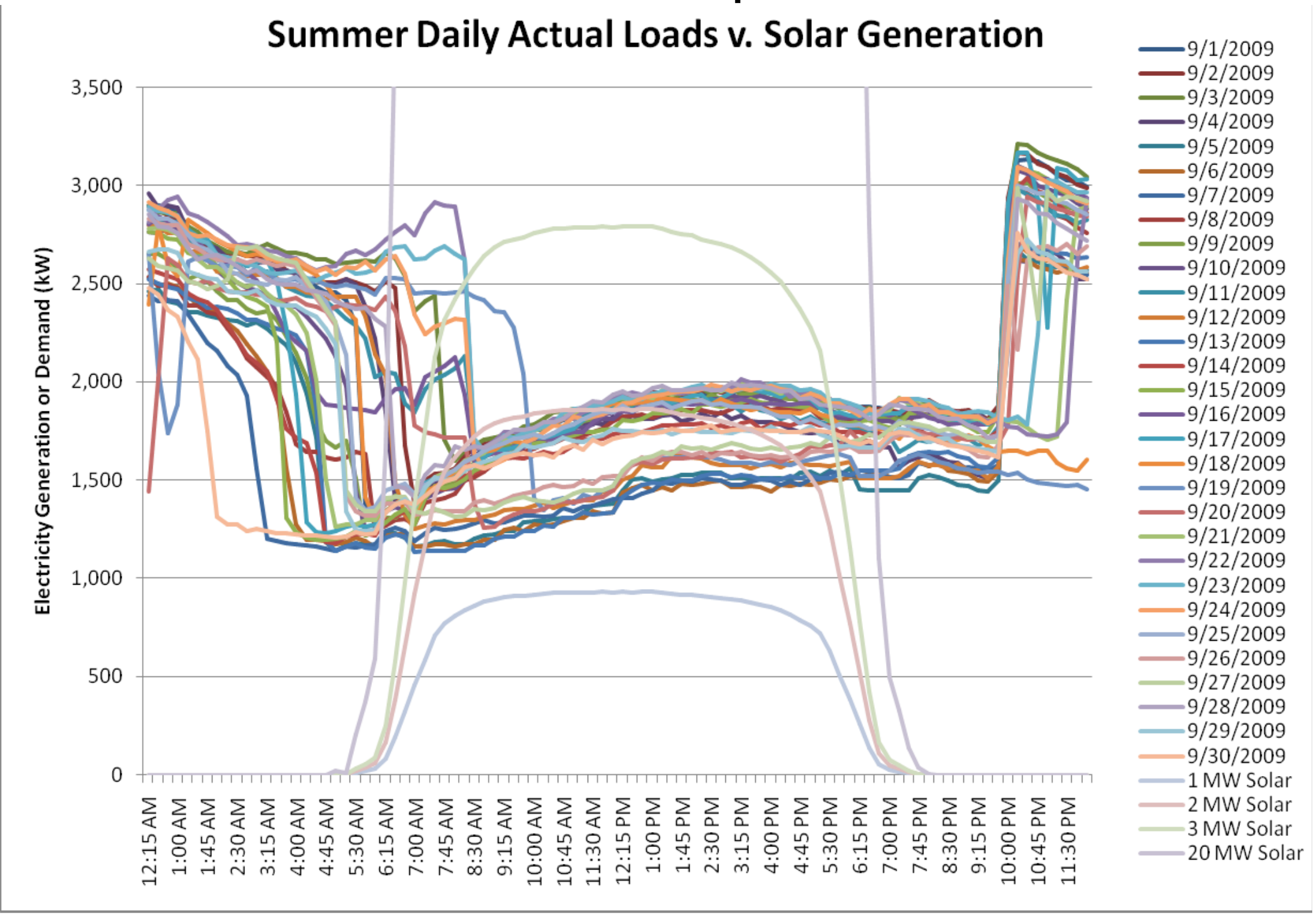
Energizing California's Communities with Renewables: Recent Successes and Future Opportunities.
California Energy Commission, July 29, 2015

- Increase student population from 6,200 to 10,000 by 2020
- More than double the footprint of the campus (100 acres to 246 acres)

Load Shape


Summer Daily Actual Loads v. Solar Generation
Electricity Generation or Demand (kW)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
12:15 AM
1:00 AM
1:45 AM
2:30 AM
3:15 AM
4:00 AM
4:45 AM
5:30 AM
6:15 AM
7:00 AM
7:45 AM
8:30 AM
9:15 AM
10:00 AM
10:45 AM
11:30 AM
12:15 PM
1:00 PM
1:45 PM
2:30 PM
3:15 PM
4:00 PM
4:45 PM
5:30 PM
6:15 PM
7:00 PM
7:45 PM
8:30 PM
9:15 PM
10:00 PM
10:45 PM
11:30 PM
9/1/2009
9/2/2009
9/3/2009
9/4/2009
9/5/2009
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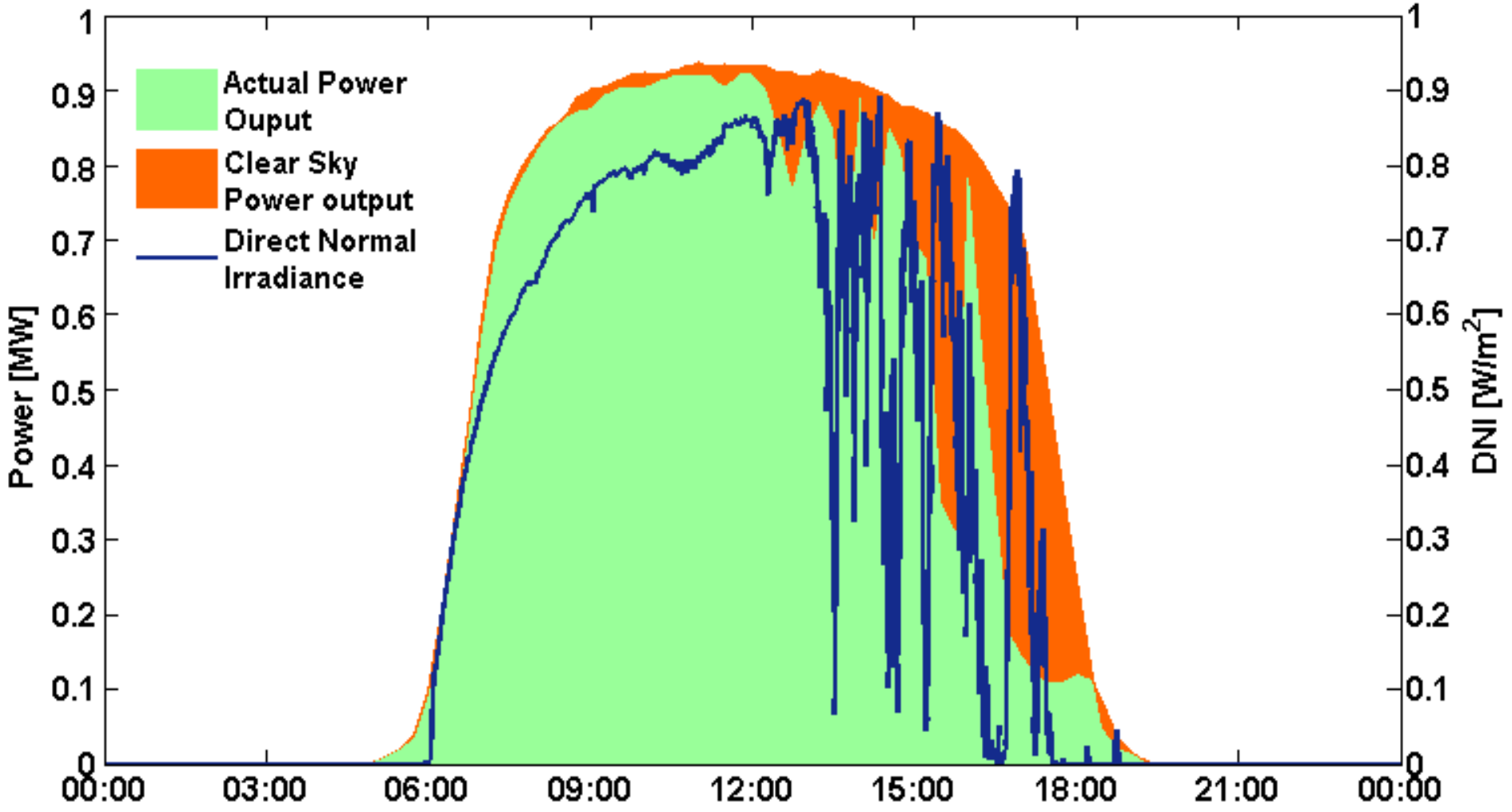
9/22/2009
9/23/2009
9/24/2009
9/25/2009
9/26/2009
9/27/2009
9/28/2009
9/29/2009
9/30/2009
1 MW Solar
2 MW Solar
3 MW Solar
20 MW Solar

Ramp Rates

Example fast drop in power from 1 MW PV array at UC Merced



06/06/2011

Source: Carlos Coimbra, UCSD

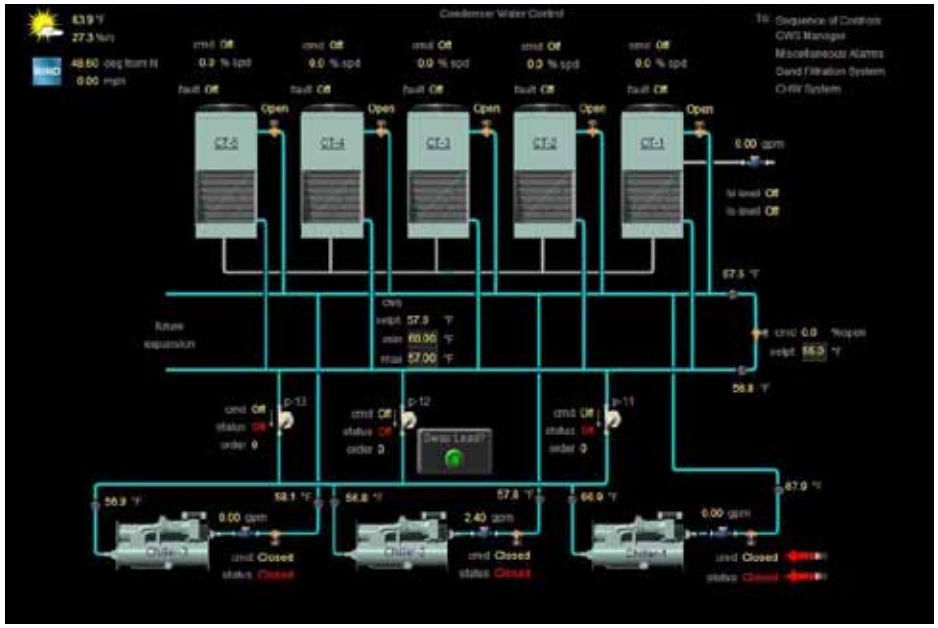
Main Goal

- Produce as much energy as we consume
- Reduce and offset all green house gas emissions produced
- Divert all waste from landfill

Objectives

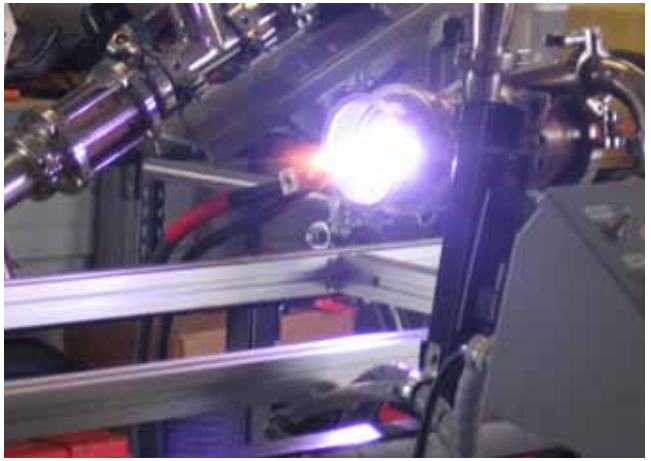
- Develop an energy performance monitoring approach so that energy efficiency and the ability to control loads can be maintained.
- Develop an integrated energy portfolio at timescales from hours to years
- Characterize intermittent solar renewable generation sources at the campus and build the capability to forecast generation and local loads.
- Advance the ability to smooth generation profiles and optimize integration strategies.
- Investigate the potential to use local waste materials for energy production.
- Develop the ability to control and dispatch energy generated through plasma gasification technology

Strategy



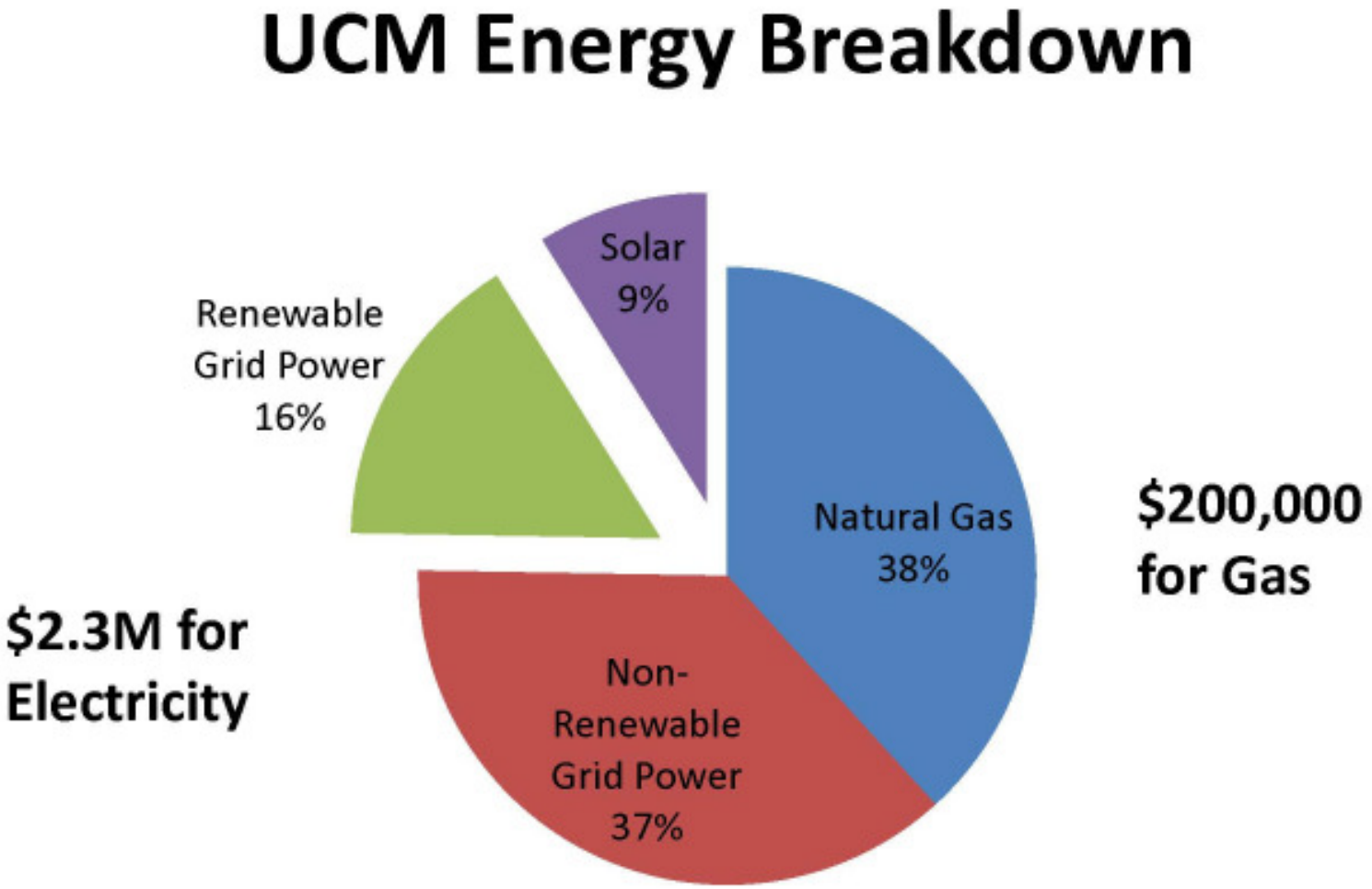
Campus Energy Efficiency

Solar Energy and Forecasting



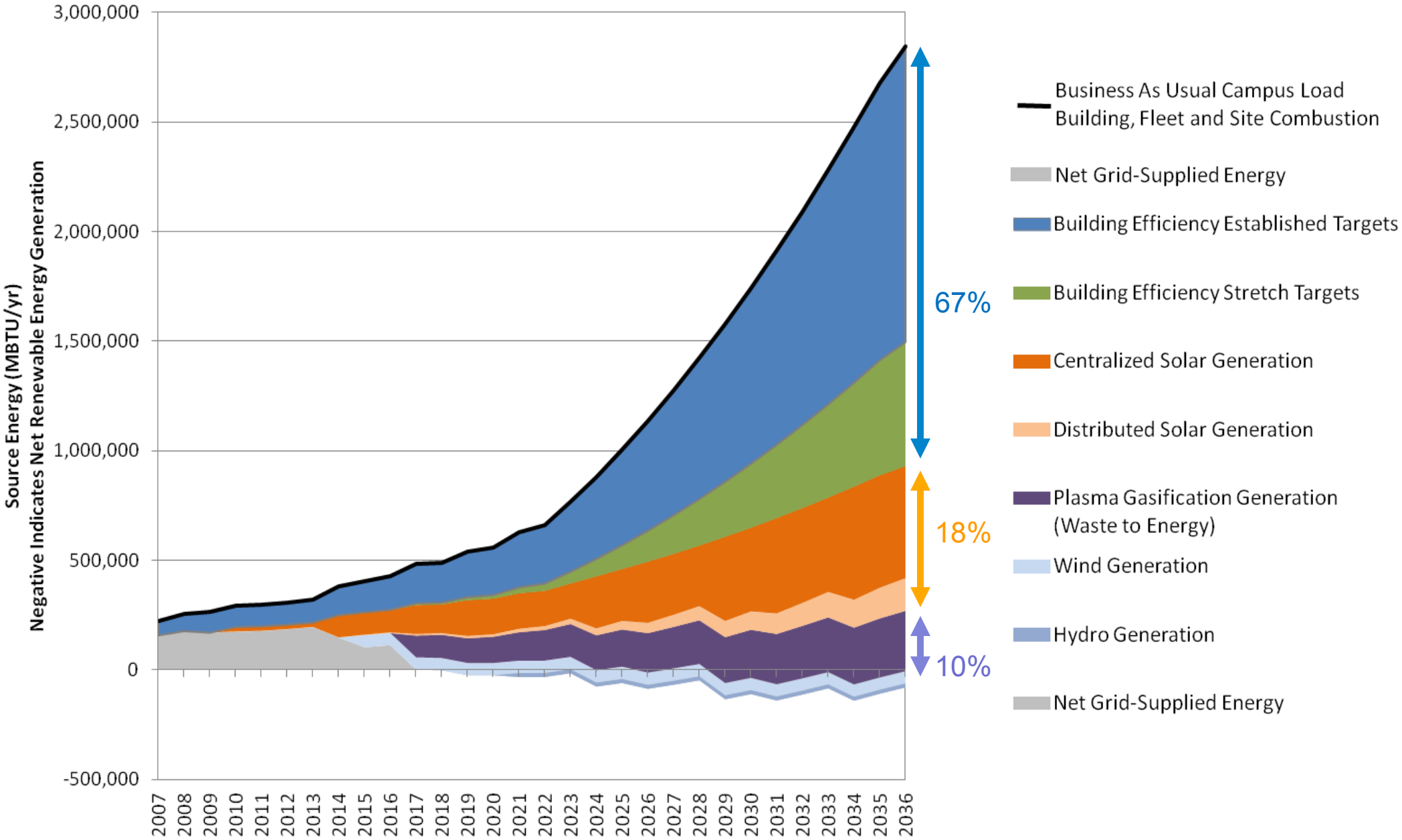
Local of Waste and Plasma Gasification

Current Energy Usage

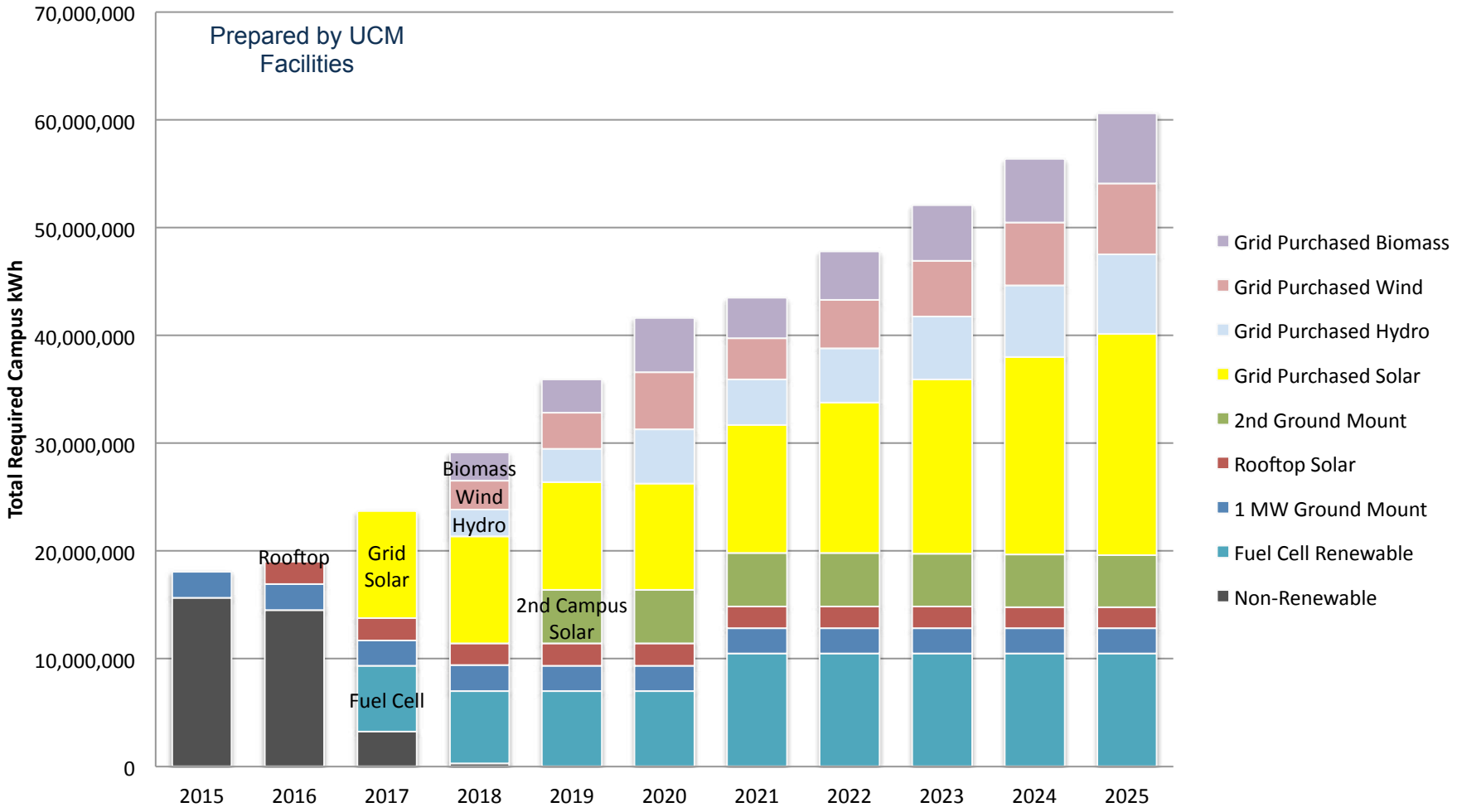


- 17 MWh per year
- Max load of 3.8 MW

UC Merced Business as Usual Load and "Wedges" to Achieve Zero Net Energy Over Campus Build-out



Updated Potential Plan

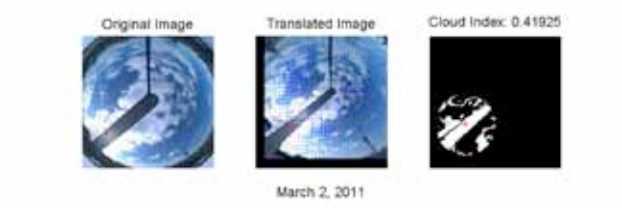


Energy Efficiency

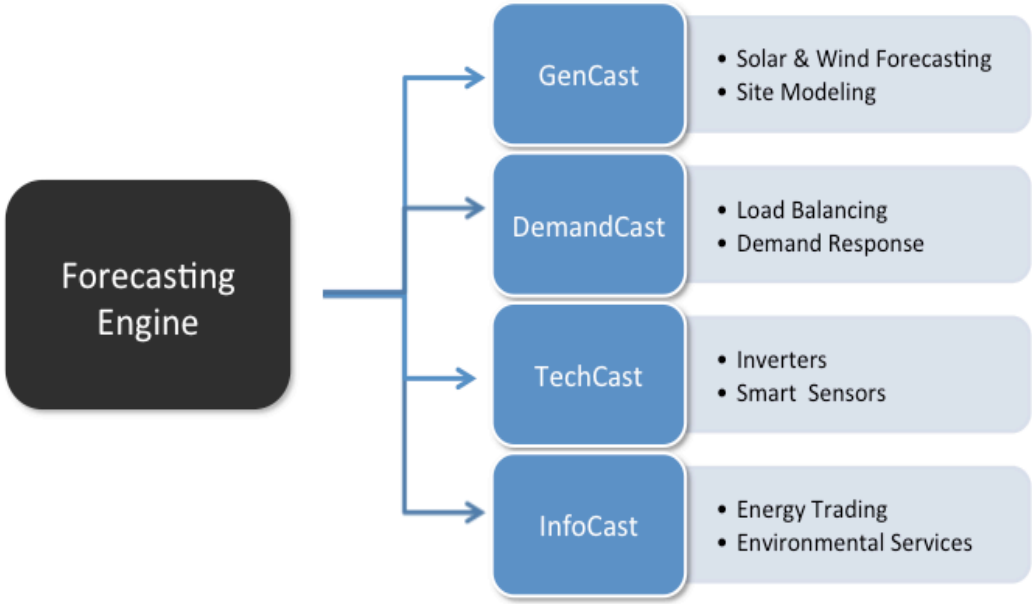
- Every Building on Campus is LEED Certified
  - 2 Platinum
  - 8 Gold
  - 1 Silver
  - 5 Pending (Projected Platinum)
- Recertified Kolligian Library as Gold
- **Next:** Classroom and Office Building

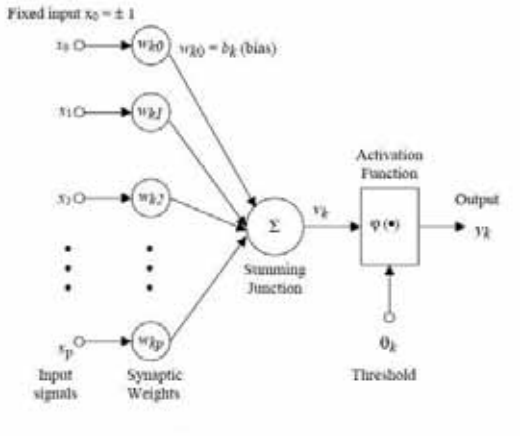
Building Benchmarks

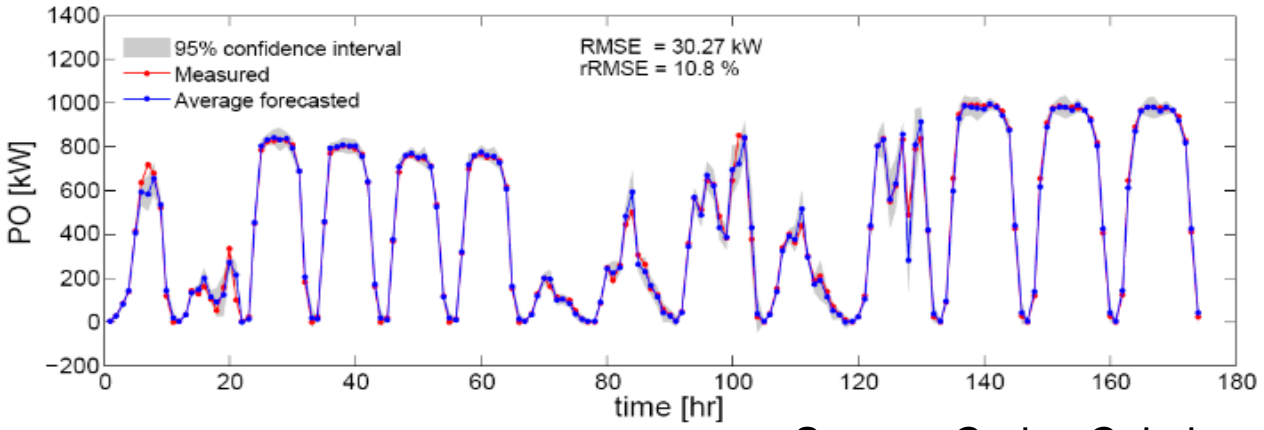
- 1999-2000 energy levels from UC and CSU buildings used to establish a baseline (Karl Brown, John Elliott)
- Different baselines established for building types:
  - Laboratory/Complex
  - Classroom and Library
  - Housing and Services
- Buildings designed initially to use 80% of 2000 baseline
- Buildings now designed to use 50% of 2000 baseline
- Some buildings currently operating more efficiently than title 24 (SSB, SE2, COB2)



Multiple Inputs Generate High-Fidelity, Full Temporal Spectrum Forecasts







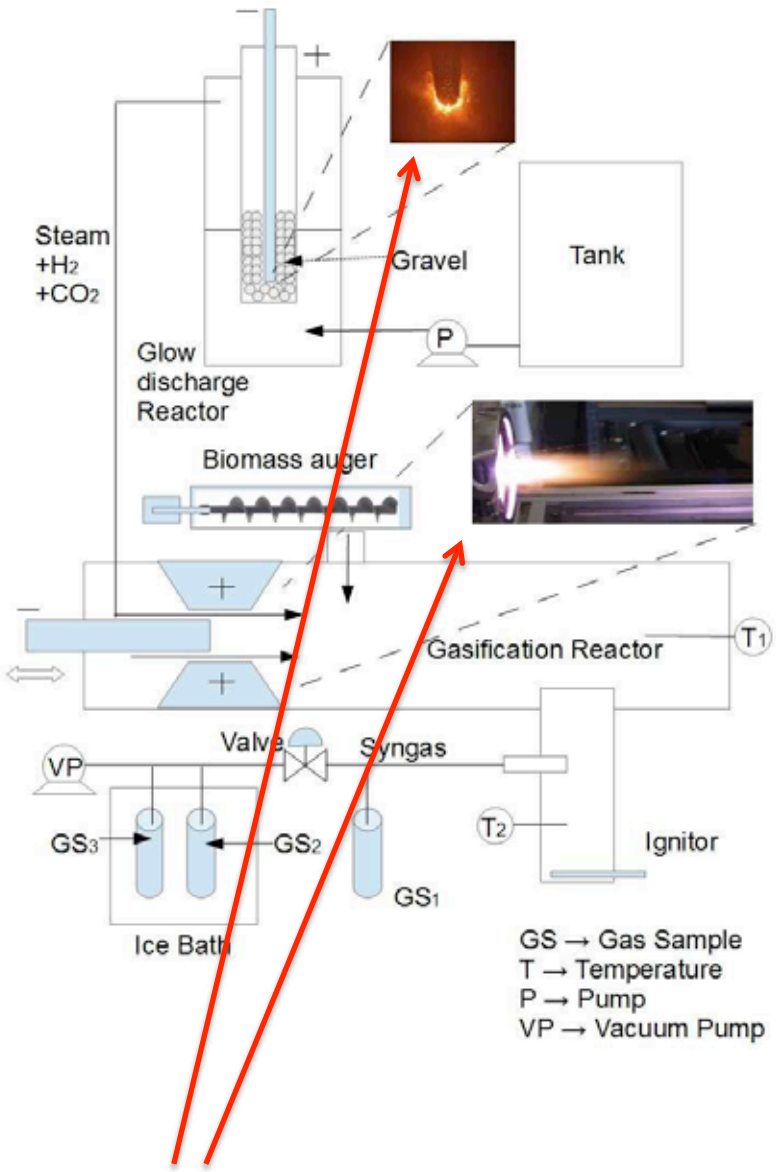
Source: Carlos Coimbra, UCSD

Zero Net Waste

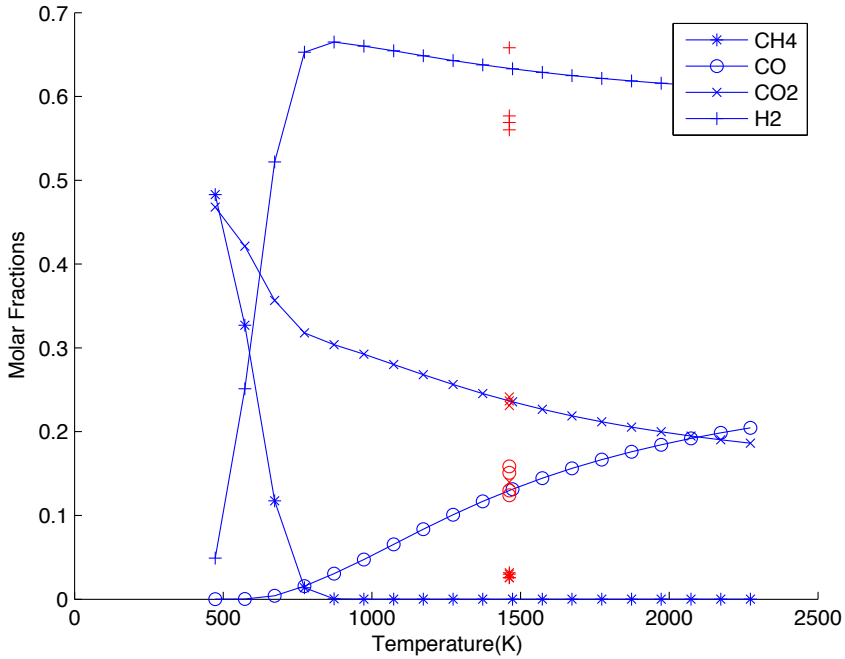
- Our goal is to divert 95% of the waste from the landfill
- Currently our diversion rate is 78% and climbing
- High quality synthesis gas through plasma gasification
- Fast start-up reaction

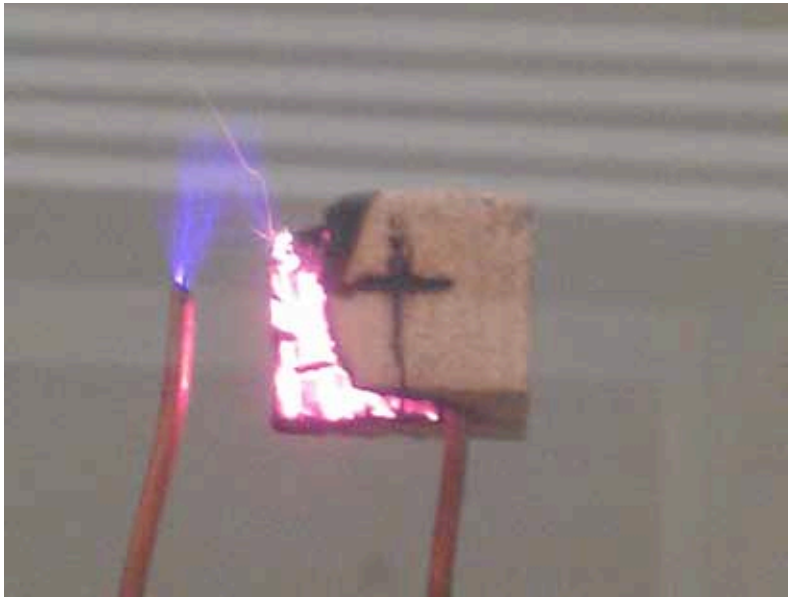
Sorting Line

Plasma Gasification



Technology by Foret Plasma Labs





Dielectric breakdown (UC Merced)

Lessons Learned

Energy Efficiency

- Get administration on board since the very beginning (implementation requires funding)
- At least LEED gold standard for future buildings
- Monitoring
- On campus generation avoids demand charges (~50% of cost)
- A portfolio helps mitigate the weaknesses of different approaches (e.g. solar only viable during the day)
- We work with UCOP for purchased electricity allows competitive rates
- State goals and President Napolitano's zero-greenhouse gas initiative help to implement strategies faster.

Solar Forecasting

- Better telemetry needed in order to obtain high-quality data and predictions (from 15min to 30 seconds resolution)
- Integrated solar-load forecasts were developed for an active community with high solar penetration levels

Lessons Learned (cont.)

Integration

- Integrated solar-load forecasts allow for ramping of dispatchable resources (such as the plasma gasification system used in this work), and contribute the overall operation of energy systems at the community level

Waste Management and Plasma Gasification

- The amount of waste generated at UC Merced is not enough to produce a significant fraction of the campus energy demand.
- The fast reaction of the plasma unit in terms of start-up conditions makes it suitable to be utilized as a power generation smoothing tool for high penetration variable output renewable energy source.
- Very high quality synthesis gas obtained >50% H2 + 30% CO
- Current diversion rates are at 78% and climbing

Acknowledgements

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